Is this chart lying to you?

Every number true, the picture misleading: the truncated axis, the honest percent, the lie factor, pictures that grow in two directions, the log scale, two y-axes. Question 1 of the ten to ask a number.

1 Truncated axis

the Gazette's bars

- **Coralia Gazette** (the toy island's newspaper): "Sales DOUBLE!" · last year **$50M** → this year **$52M** (M = million)
- Axis starts at **49** → bars `50 − 49 = 1` and `52 − 49 = 3` units tall → looks ×3
- **Truncated axis** = bar axis starting above 0 → bars no longer show the real size
- **Rule** → bar chart compares lengths ⇒ axis from **0**, values shown · line chart may zoom, if it says so
- Practice: fish 80 → 84 tons, axis at 76 → bars 4 and 8 (looks ×2) · from 0: almost equal



2 Honest number

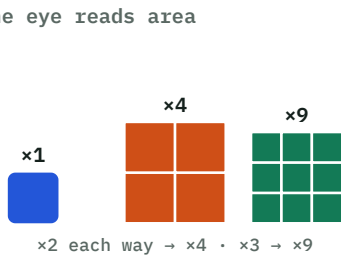
percent change

- **Percent change** = `rise ÷ start × 100` · `52 − 50 = 2` → `2 ÷ 50 = 0.04` → **+4%**, not +100% · practice: `4 ÷ 80 = 5%`
- Divide by the **start** (last year), never by the new value

3 Lie factor

Huff · Tufte

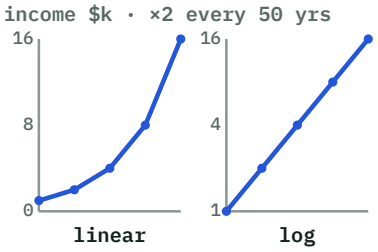
- **Darrell Huff** · American journalist · How to Lie with Statistics (**1954**) → cut-axis chart = "**gee-whiz graph**"
- **Edward Tufte** · American statistician (data expert), Yale University · The Visual Display of Quantitative Information (**1983**)
- **Lie factor** = `change in picture ÷ change in numbers` · honest = **1**
- Gazette: bars 1 → 3 = +200% · numbers +4% → `200 ÷ 4 = 50` · practice fish: `100 ÷ 5 = 20`
- **Picture in 2 directions** → area grows twice: coin ×2 tall, ×2 wide → area ×4 (+300%) for +100% → **3** · rice sack ×3 × 3 = ×9 (+800%) for ×3 (+200%) → **4**



4 Log scale

amounts vs growth

- **Linear scale** = equal steps = **+ same amount** · **log scale** = equal steps = **× same factor** (1, 2, 4, 8, 16)
- Coralia: income ×2 every 50 years ($1k → $16k in 200 · k = thousand) → linear: flat, then shoots up · log: **straight**
- Straight on log ⇒ same **percent** each year (×2 / 50 yrs ≈ **1.4%**/yr) · bending up on log ⇒ growth rate rising
- Real: world income per person (Maddison Project: Angus Maddison, British economic historian · 2011 prices, so only real changes) **$1,128** (1820) → **$16,677** (2022) ≈ **×15** · log bends up: <1%/yr (1900–50) → ~2% (1950–2000)
- Practice: town A +1,000/decade (+100%, +50%, +33%, +25%) → flattens on log · town B ×2/decade → straight
- Which lies? **neither** if the scale is labeled · a hidden scale lies



5 Honest or not

sort it · two y-axes

HONEST	MISLEADING → fix
bars from 0, values printed · line zoomed, labeled "zoomed" · log scale labeled "log scale"	bars from 49 or 900, unlabeled → start at 0 · log scale not said → label it · picture ×2 tall and ×2 wide → grow one way, or draw 2 pictures · **two y-axes** → one axis, or two charts

- **Dual axis** = 2nd y-axis (upright scale) on the right → each line its own scale → where lines cross means **nothing** · practice: Coralia exports (sales abroad) 60 → 80 (left, 0–100) vs Palmera 4 → 8 (right, 0–10) meet in year 5 → `80 ÷ 8 = 10` times · Palmera +100%, Coralia +33%

6 So what?

question 1 of 10

- **Ten questions to ask a number** · **1 · Where does the axis start, and what is its scale?**
- Gazette rewritten → "Sales up **4%**, from $50 million to $52 million" · not evil: someone **chose** the axis → see the choice
- Use it on every chart: every Walrasia course, the news

Watch out: a tall bar ≠ a big change → read the axis first · ×2 in the numbers is +100%, ×3 is +200% · "area" grows as height × width · a log chart is not a lie, a hidden log chart is